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MEMORANDUM REPORT ARBRL-MR-03132

OPERATING THE TANK WARS MODEL: RECENT CHANGES FOR EXPLICIT MOTION, ETC.

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September 1981

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BALLISTIC RESEARCH LABORATORY
ABERDEEN PROVING GROUND, MARYLAND

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER MEMORANDUM REPORT ARBRL-MR-03132	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* OPERATING THE TANK WARS MODEL: RECENT CHANGES FOR EXPLICIT MOTION, ETC.		5. TYPE OF REPORT & PERIOD COVERED 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR*(s)* Fred L. Bunn		8. CONTRACT OR GRANT NUMBER*(s)*
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Ballistic Research Laboratory ATTN: DRDAR-BLB Aberdeen Proving Ground, MD 21005		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 1L162603AH80
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Command US Army Ballistic Research Laboratory ATTN: DRDAR-BL Aberdeen Proving Ground, MD 21005		12. REPORT DATE SEPTEMBER 1981 13. NUMBER OF PAGES 16
14. MONITORING AGENCY NAME & ADDRESS*(If different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Armor
Combat Simulation
Fire Control
Projectile

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The TANK WARS model has been extended to include explicit gross motion and a number of other changes both major and minor. The motion changes require changes to the input files, but most of the other changes do not affect the inputs. The Users' Information Manual is still the basic document describing the inputs to the model. This document only discusses changes since that users' manual was written.

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INTRODUCTION

I've made a number of changes to the TANK WARS model since July 1980. The major changes are:

- The model now treats gross vehicle motion explicitly.
- F-killed tanks now try to reach full defilade.
- Tanks that are both M-killed and F-killed are considered sensed kills after a period of inactivity.
- Missile systems now wait for missile impact before moving out.
- The win criteria is that the winner has at least one tank able to fire and the loser has none that can.
- The model now finds the expected kills per stowed load in the case of one blue vs n reds.

All but the last two changes require changes in the inputs. The changes occur in the old 'misc' and 'acc' files, and I have added a completely new type of input file, the 'path' file. Table 1 shows the correspondence between the old and new input files. Now let's proceed to a file-by-file discussion of the inputs in the new and changed files.

TABLE 1. INPUT FILES

Old	New	Comment
blue.misc	gamec b.misc	First 3 lines of old blue.misc Last n-3 lines of old blue.misc with a few changes
red.misc	r.misc	A few changes
blue.acc red.acc	b.acc r.acc	Changes in M-S format Changes in M-S format
blue.pkh red.pkh	b.pkh r.pkh	No changes No changes
	b.path r.path	Defines explicit gross motion Defines explicit gross motion

THE GAME CONTROL FILE

The game control file is named 'gamec' and contains just three lines of information. Table 2 is a sample of such a file. It is the first three lines of the old blue.misc file and it has changed very little. The first line of the file contains five numbers, the first two of which are for future use. The third and fourth are the standard input and output units, and the fifth is set to 1 or 2, depending on which of two distributions of initial target orientations are desired. Values for these two distributions can be modified in the inito routine.

As shown in Table 2, the second line of the file contains the values of 10 'keys' that are used to turn on or turn off various print statements in the program. The normal user will only be interested in keys 1, 3, and 4 while the other keys turn on print statements of value to someone maintaining or extending the program. Table 3 is a new description of these keys.

Again, referring to Table 2, the third line contains four numbers, the number of blue combatants, the number of red combatants, the 'scenario' and the maximum time that an engagement will run. The scenario is either a meeting engagement with all fully exposed, or a red attack with red fully exposed and blue in hull defilade, or a blue attack with blue fully exposed and red in hull defilade.

TABLE 2. SAMPLE GAME CONTROL FILE

Data	Comments
3,500,5,6,2,	mainbr,nreps,in,out,iangd
2,0,2,1,1,1,1,1,1,1,	keys[lev,tr,echo,sk..]
1,2,2,600,	nblue,nred,scene,maxt

TABLE 3. KEY SETTINGS IN THE GAME CONTROL FILE

Variable	Val	Resulting Action
key(1) =	0	Print only summary of all reps
	1	Print above + summary of each rep
	2	Print above + event history
	3	Print above + paths (unformatted) & bullets (unformatted)
	4	Same as =2 + paths (formatted) & bullets (formatted)
	5	Same as =2 + x,y motion (in peek)
key(2) =	1	Trace entry to and exit from all major routines
key(3) =	1	Echo some input
	2	Echo more input
	3	Echo above + pkh tables
	4	Echo above + pkh calculations (in rdpkh)
key(4) =	1	Print all events as they are scheduled and cancelled
key(5) =	>0	In path print firer, tlast, time. delay
key(6) =	>0	In kill print narmy, nrg, nang, nhdfe, ndisp, kill, p, psave
key(7) =	>0	In switch print firer, tgt, e, p, z In nrold print time, life(i), knceal(tgt), FD, i
key(8) =	-1	In engage print armyf, ishtfs, firer, motion, STATNY
	>0	In mokill print t, tgt, color(narmy), n, irg
key(9) =	-1	In init print i, aspect(i,TURRET) In halt print firer, tgt, armyf, nrg
	>0	In impact print low rd for HD target In rgf print position and velocity of firer and tgt In geterr print theta, temp, iang, sserrs, r, vtgt, vfirer, firer, narmy In izhit print tgt edges & impact point In path print i, t, dt, tbl, etc
	1	In nrseg print tbl
key(10) =		(unused)

THE MISCELLANEOUS DATA FILES

There are very few changes in these files. Table 4 shows a sample file. The changes are as follows:

- In line 9, we add 'ismsl' which is set to 1 if this is a missile firing system and 0 otherwise.
- In line 14, we add 'accel', 'decel', and 'thide'. Accel and decel are the vehicle acceleration and deceleration (in meters per second squared). Thide is the time for an F-killed vehicle to reach full defilade (in seconds).
- In line 15, we add 'ishtfs', 'nbump', and 'tbump'. Ishtfs is set to 1 if this is a halt-to-fire system and 0 otherwise. After an M&F-kill on a vehicle the kill level is 'bumped-up' to a K-kill if the vehicle is hit nbump times or when tbump seconds elapse.

TABLE 4. MISCELLANEOUS DATA FILE

Data	Comments
.81,1.47,2.08,2.09,1.52,1.83,3.76,3.76,	tgtdim
0.,0.,0.,0.,0.,0.,0.,0.,	psense
1.,1.,1.,1.,1.,.92,.39,.0,	pinfin(hd tgt)
1.,1.,1.,1.,1.,.97,.46,.0,	pinfin(fe tgt)
6.35,7.4,9.77,13.5,19.7,32.,72.7,1.e6,	tbar(hd tgt)
1.16,1.3,1.64,2.23,3.21,5.18,11.7,1.0e6,	tbar(fe tgt)
1,	ndets
120.,	tlook
50,1,1,1,0,	nrds,nrpt,nrpb,tactic,ismsl
.34,.69,1.04,1.41,1.78,2.16,0.,0.,	tof
7.4,8.8,10.1,11.4,12.8,14.1,99.,99.,	tfirst
14.8,0.25,	tmedin,rof
0.,0.,0.,0.,0.,0.,0.,0.,	tfixed
1.0,2.0,60.,	accel,decel,thide
0,3,25,	ishtfs,nbump,tbump
above file is data/misc/671xm.5mar81	
accel,decel,nhits changed	

THE DELIVERY ACCURACY FILES

The moving-stationary portion of the delivery accuracy files has been reformatted. In the previous version, I root-sum-squared the stationary-stationary errors with the moving-stationary add-ons offline to produce the moving-stationary errors. These moving-stationary errors were then placed in the delivery accuracy files. The problem with this method is that only one firer speed was stored in the file at a time and to store more would require several pages more moving-stationary errors. In the new version, I just put the moving-stationary add-ons in the delivery accuracy files and let the computer root sum square the add-ons with the stationary-stationary errors to produce the moving-stationary errors for the appropriate speeds. Table 5 shows the interesting portions of a sample delivery accuracy file.

The first line of moving-stationary numbers is a set of firer speeds (m/s). The second and third lines are the horizontal and vertical add-ons for the respective speeds (mils).

TABLE 5. THE MOVING-STATIONARY ADD-ON DATA

```
12  7 S-S Errors for Stationary 1234 firing a 789 rd vs a Stationary tgt.
                .
                .
                .
16  7 S-M Errors for a Stationary 1234 firing a 789 rd vs a Moving tgt.
      evasive fac=.25, ccw, speed=10kps
                .
                .
                .
 8  M-S add ons. Good stabilization for the 1234 over terrain type IV
                0.00    1.11    2.22    3.33    4.44    5.55    6.66
                0.00    .4      .4      .4      .45     .51     .56
                0.00    .4      .4      .4      .4      .46     .54
data/delacc/4000m.bg
```

PATH FILES

Motion data appears in three types of files: 'x.misc', 'x.acc', and 'x.path' files. The first two types of files have already been discussed. The path data is stored in two files, one for blue and one for red.

Tables 6 and 7 show two path files. Table 6 contains the nominal path for a stationary vehicle, and Table 7 contains the nominal path for a vehicle moving along a path that has two segments. I call these paths nominal paths because the vehicles on a side are usually spread out around the nominal path and don't travel exactly on it; they parallel it. They don't usually reach segment ends at the exact times indicated in the path data either; the times given in the path data are for the tank moving at nominal speeds. Halt-to-fire systems and M-killed systems will slow down and as a result move slower than the nominal speeds.

The first record (line) in each path file is a header record and is not used by the computer. The next group of records defines motion along the segments of the vehicle path. The n segments are defined by their n+1 endpoints. The last record in this group has a '99999' in its first field. After that, there are some more records, one for each vehicle on the side. This last group of records gives the offset of each vehicle around the nominal path.

To define a path, give infomation for each segment end point. The information required is:

- Nominal time the vehicle is at the end point,
- The x,y coordinates of the vehicle at that time,
- The v_x,v_y velocity coordinates at that time.

Follow these records with the x and y offsets for each vehicle on the side. You can put in offsets for additional vehicles, and the program will simply read as many offsets as it needs.

TABLE 6. PATH FILE FOR A STATIONARY VEHICLE

t	x	y	vx	vy
0	0	0	0	0
99999	0	0	0	0
300.,20.				
500.,20.				
700.,20.				
900.,20.				
1100.,20.				
1300.,20.				
1500.,20.				

TABLE 7. PATH FILE FOR A MOVING VEHICLE

t	x	y	vx	vy
0	500	2000	-4.96	-9.93
121.0	-100	800	0	-11.1
166.0	-100	300	0	0
99999	-100	300	0	0
300.,0.				
600.,0.				
900.,0.				
1200.,0.				
1500.,0.				
1800.,0.				
2100.,0.				

INTERACTIVE INPUT

Run TANK WARS by entering the /tank/fred/m.n directory on the PDP 11/70 and saying 'x11 n', where n has the value 1-4 with the results shown in Table 8.

TABLE 8. THE RUN COMMAND PARAMETER

Value	Result
1	'Demo run' (same as 2 now)
2	Run a single replication
3	Run n replications
4	Special run (depends on current programming in specil.f)

After the program starts running, it will grind away for a while, reading input in the read routines and setting up pkh tables in the rdpkh routine. Then it will ask for the 'scenario', the 'random-nr-seed', and either the 'rep-number' or the 'nr-of-reps'.

For scenario type in 1, 2, or 3 depending on whether you want a meeting engagement, a Red attack, or a Blue attack. For random-nr-seed insert a four or five digit number, for rep-number insert a 1 unless you are interested in a particular replication from a multi-rep run. If you're interested in a multi-rep run and want a statistically significant sample size, set nr-of-reps to at least 500. After it gets done running, it will ask for the next set of such information.

When you've run everything you want, just input a zero and the program will quit.

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